The Distributed Integrated Ocean Prediction System

http://diops.spawar.navy.mil

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Rapid Transition

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Outline

- DIOPS Overview
- Models:
  - WAM
  - SWAN
  - PCTIDES
  - SURF
- Exercise Support
- WaveWatch3 Spectra Import
- Future Plans/Summary

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DIOPS Objective

Provide world-wide relocatable wave & surf capability to METOC Centers and fleet units that includes:

- Easy transition for coming advancements (SWAN, Delft-3D)
- Effective training and documentation
- Pathway for Real time data injection
- Provide scientific expertise & workstation @NPMOC
- Beta Test site for DIOPS/SWAN established @NPMOC-SD

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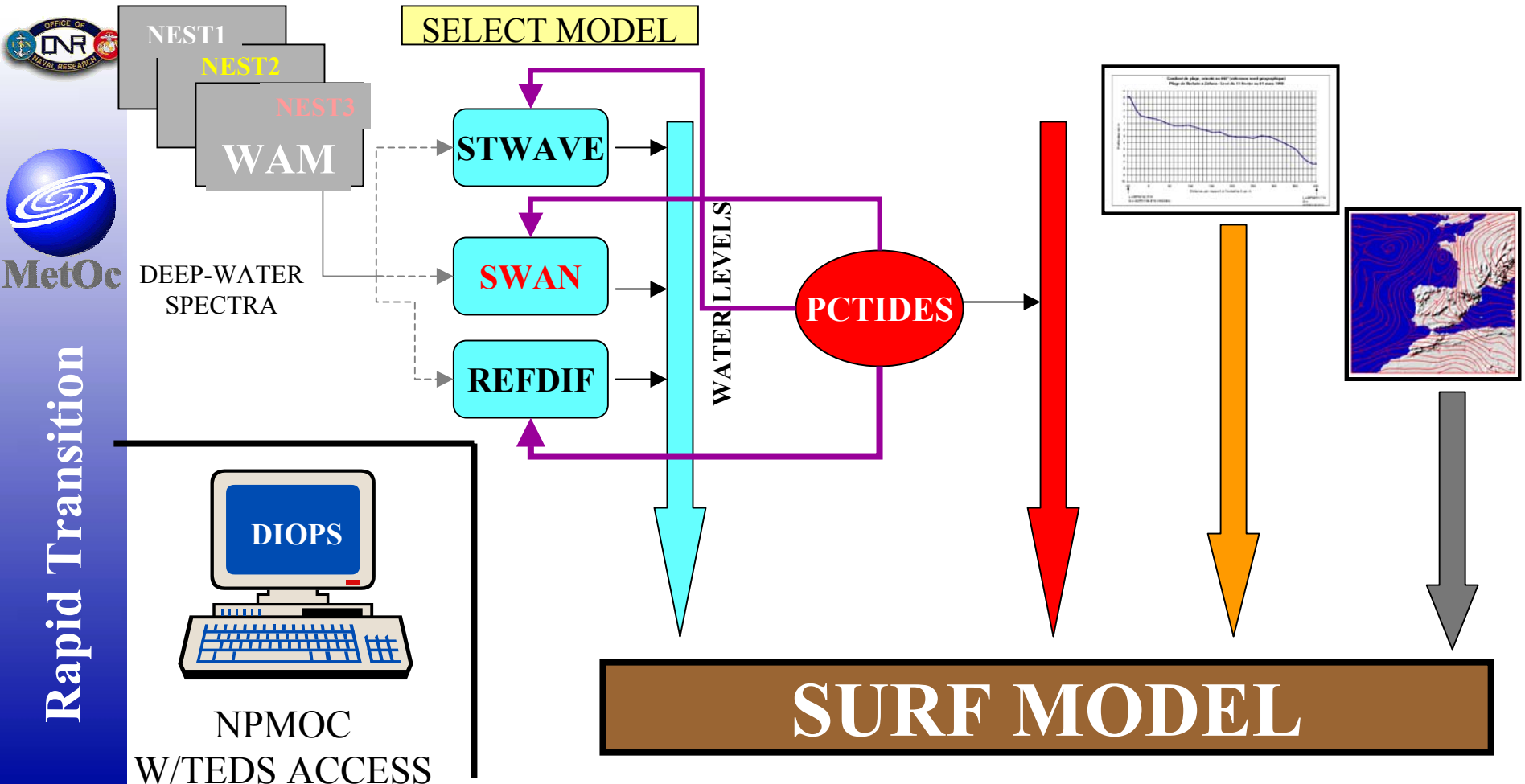
DISTRIBUTED INTEGRATED OCEAN PREDICTION SYSTEM (DIOPS 2.0)

SHALLOW-WATER SPECTRA | TIDES | BEACH PROFILES | WINDS



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DIOPS Hardware

- **DIOPS Workstations**:
  - Sun Ultra 80 Dual processor 450 Hz
    - SunBlade 100 Single Processor
  - 2GB RAM, 72 GB storage
    - 1 GB RAM 40 GB storage
  - Fortran 77/90 C/C++ compilers
  - 4mm tape drive
    - Floppy/Smart Card Drives
  - Current visualization done with GMT/GrADS plotting software
  - Developing DII-COE COP based visualization segment.
  - Integration of METOC data into CC picture

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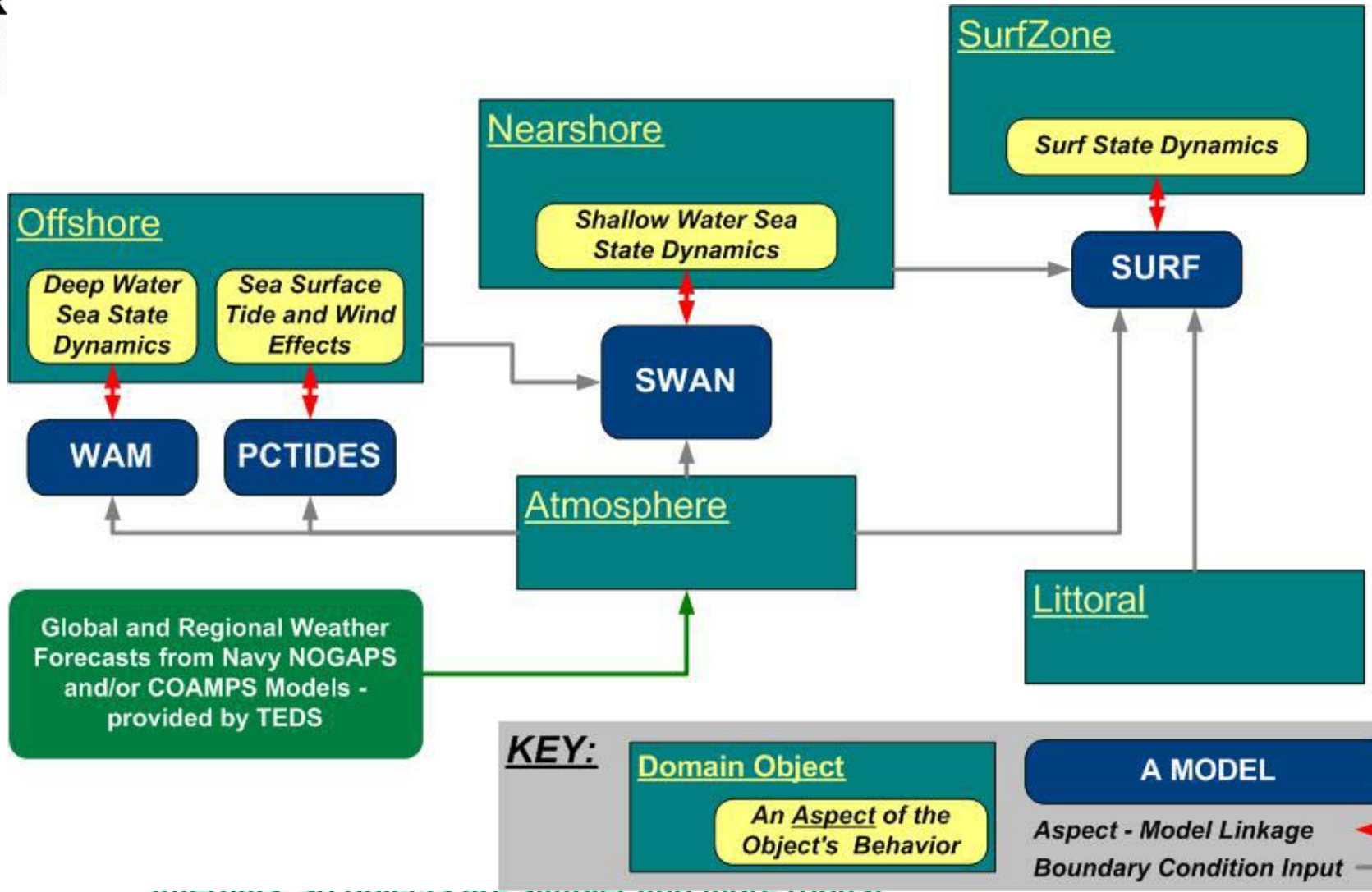
Dynamic Information Architecture System (DIAS)



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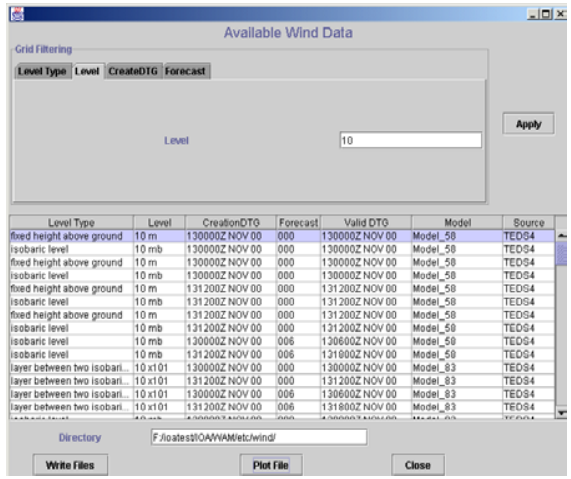
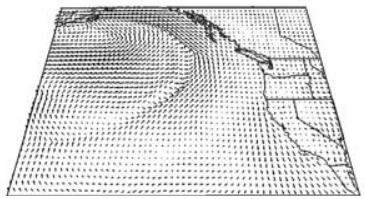
TACTICAL ENVIRONMENTAL DATA SERVER (TEDS)

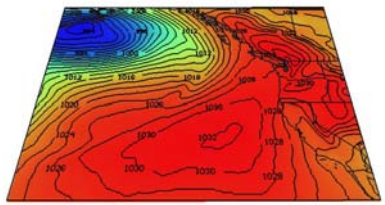
The Tactical Environmental Data Server (TEDS) provides dynamic access and storage to METOC data (e.g., analysis/forecast grid field data, observations, bulletins, remotely sensed data in a heterogeneous networked environment. DIOPS model inputs such as wind forcing, sea level pressure and bathymetry are provided via TEDS.



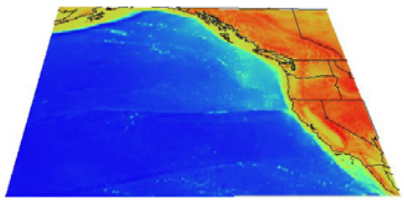
List of available TEDS global atmospheric fields.



COAMPS WINDS



SEA LEVEL PRESSURE



BATHYMETRY (DBDB-V)

TEDS environmental data is served to the DIOPS suite of models. TEDS Application Program Interface (API's) calls provide bathymetry and atmospheric forcing to be used as model inputs. DIOPS model outputs can also be distributed via TEDS.

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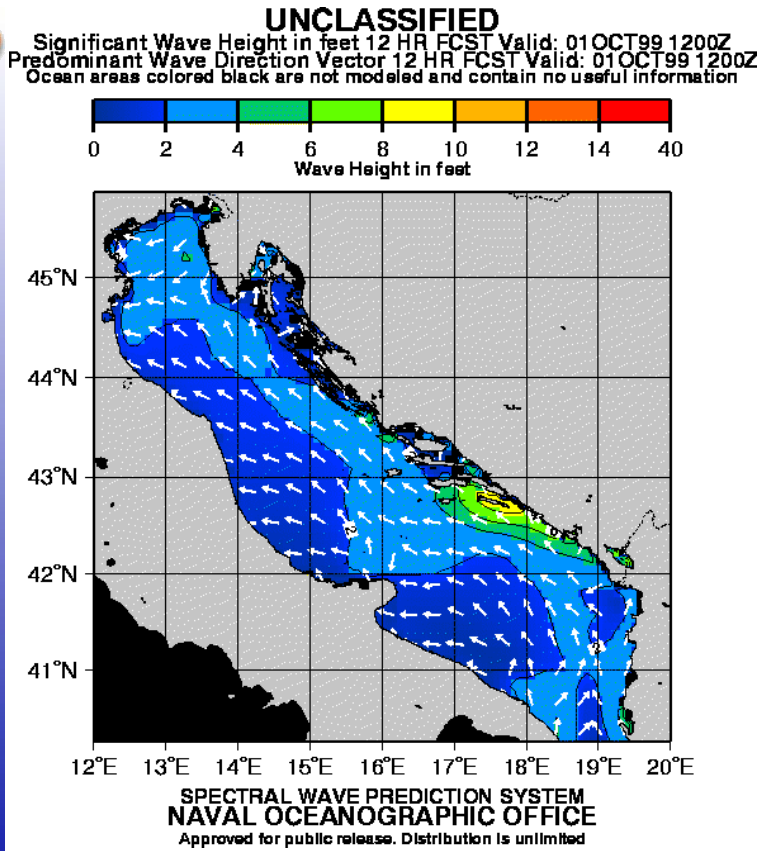
Regional WAM



- **Run operationally by NAVO**
- **Nested model, BC from global WAM, basin-scale model**
- **Variable resolutions**
- **25 frequencies, 24 dir.**
- **Forced with NOGAPS, COAMPS wind stresses**
- **Valid to depths of 20-30 ft.**

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Simulating WAves Nearshore (SWAN) Model & Improvements

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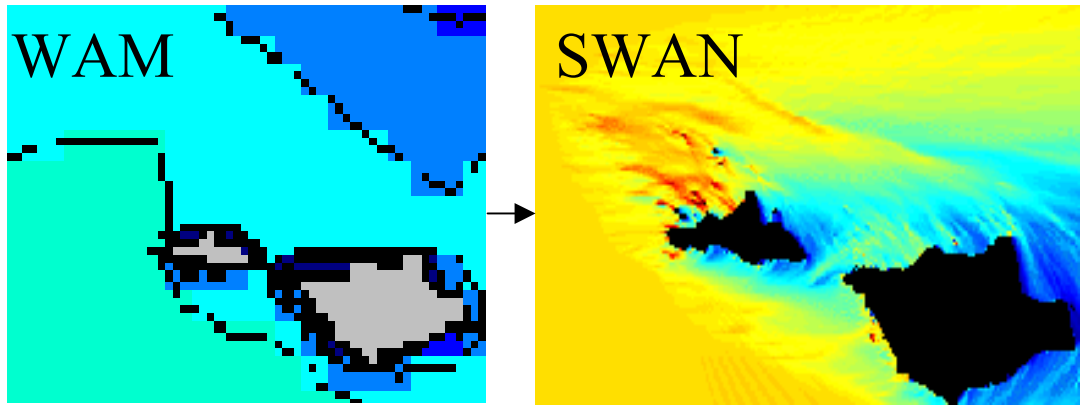
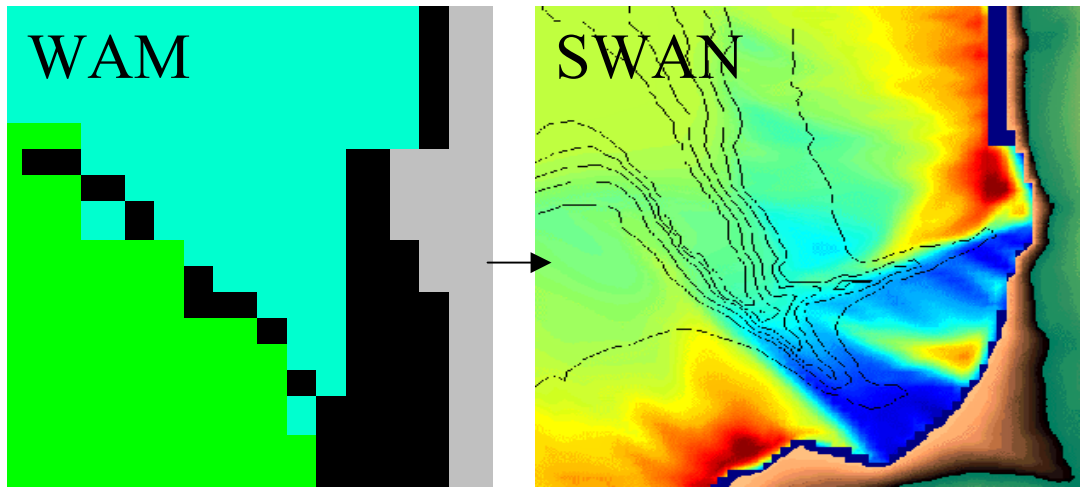
Features

- Refract/Shoal
- *Ocean/bay/lake*
- Wind growth
- Breaking
- Bottom Friction
- Currents
- *Time dependent/ steady state*
- Full plane model
- Validation studies
- *Wavewatch*
- R&D path
- In Delft3D



1/12th degree

100 m

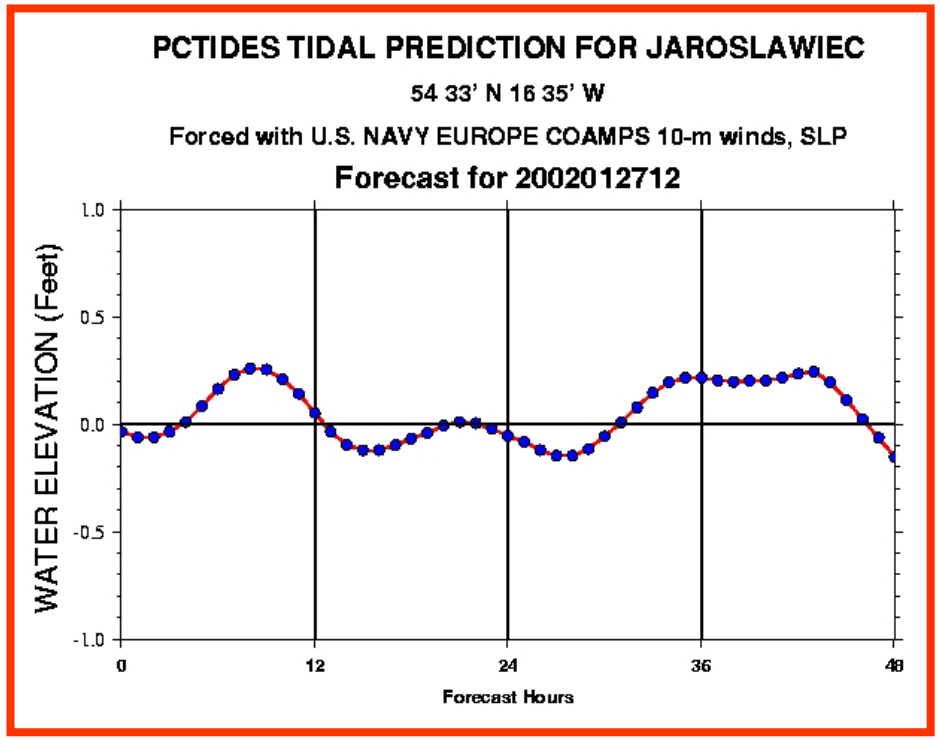


1/12th degree

100 m

PCTIDES

- Developed at NRL
- Atmospheric affects on astronomic tides
- Relocateable
- Ease of use
- MSLP and 10 m winds
- Nestable
- IHO tide stations



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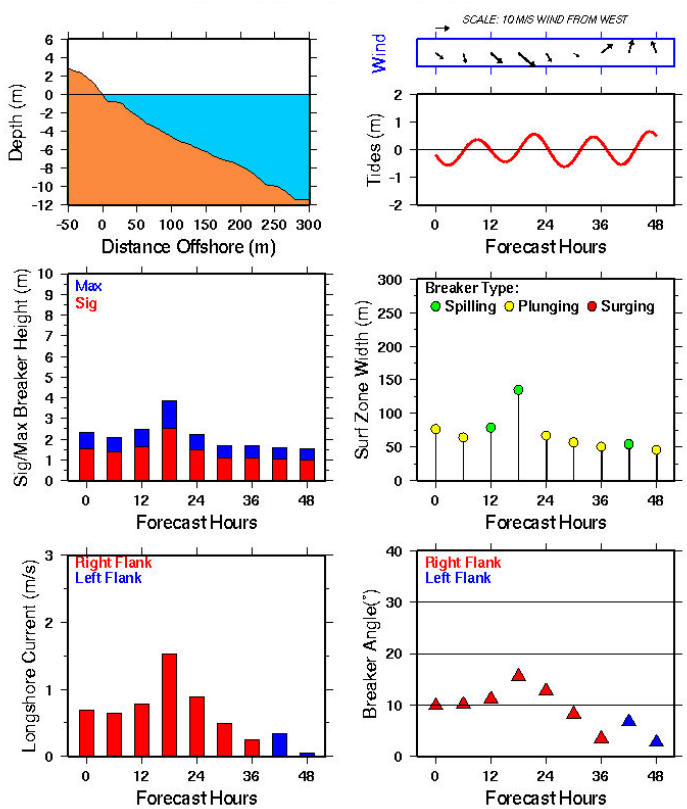
Navy Standard Surf Model (SURF3.1)

- **Developed by Marshall Earle, OAML approved**
- **1-D, based on Thornton & Guza (1983)**
- **Easy operation and mathematically robust for non-expert use**
- **Provides information across surf zone: breaking wave heights, types, and surf statistics**
- **Computes longshore current and modified surf index**
- **Validation report based on 1900+ observations at Duck, NC completed.**



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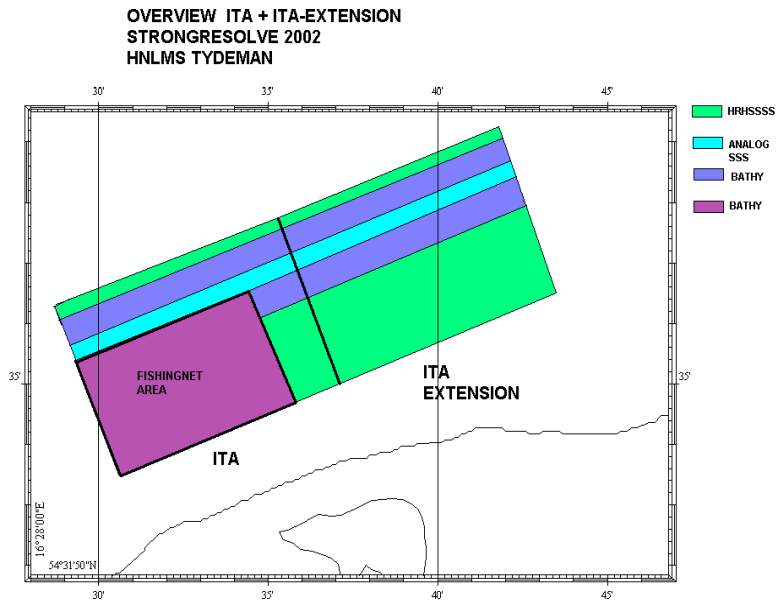
DIOPS Support to NATO Exercise SR02

- DIOPS provided integrated wave, tide and surf predictions running DIOPS from NEMOC-Rota
- Ingested REA collected bathymetry into DIOPS
  - SWAN: Provides a comprehensive, detailed, geographic depiction of waves along the AOI.
  - Navy Surf 3.1: Provides generalized surf analysis and forecasts, supporting currently used tactical decision aids, for the AOI



High-resolution bathymetry collected during REA phase injected into DIOPS using SMS.

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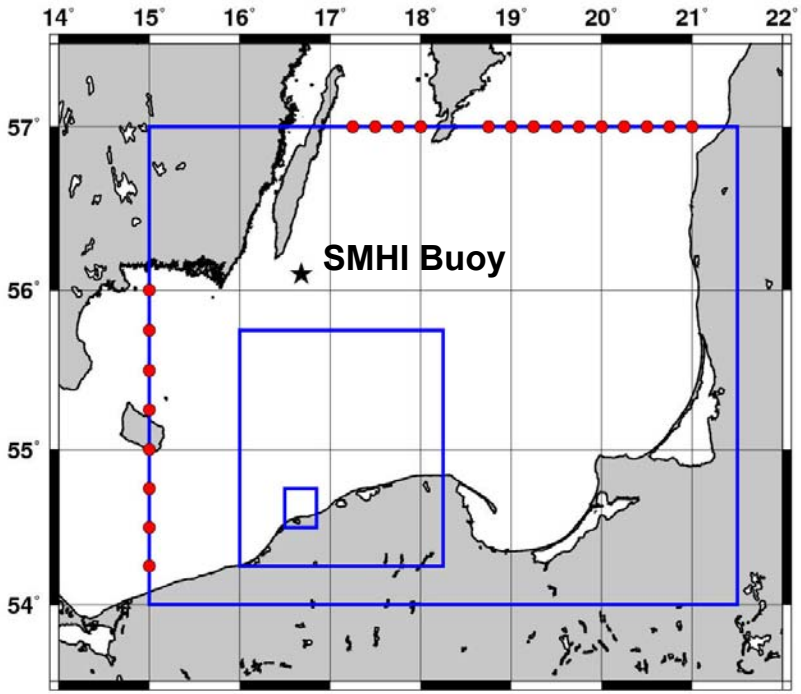
Strong Resolve ‘02



- Baltic Sea WAM (0.25° resolution) forced with NOGAPS winds.
- 3 SWAN nests
  - Outer nest forced with WAM spectra (red circles)
  - COAMPS winds
  - Inner-nest utilized REA bathymetry
- Surf predictions for 4 beach locations along Polish Coast
- Tidal range small (+/- 10 cm)

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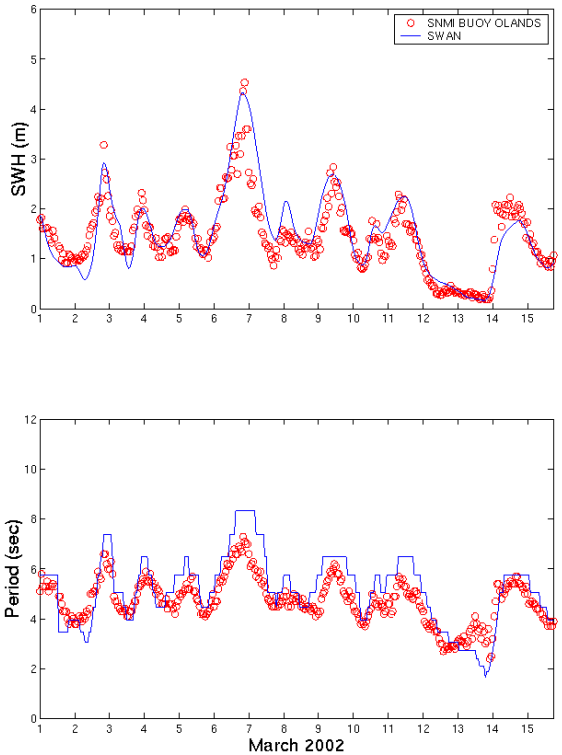
Strong Resolve ‘02



SWAN results versus Swedish Buoy in the Baltic Sea.

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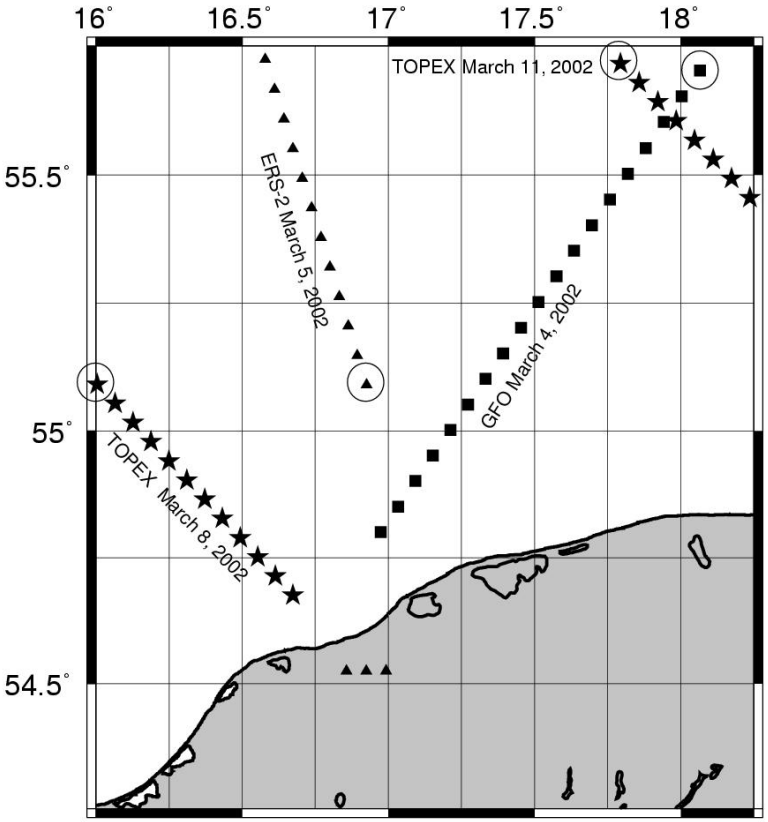
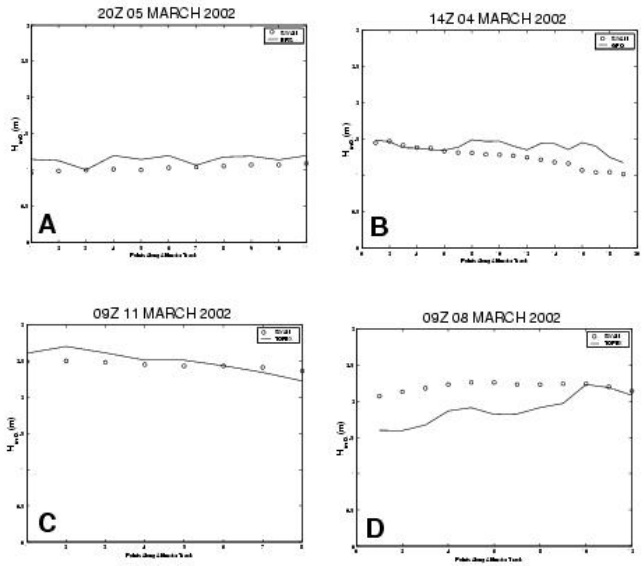
MetOc

SWAN versus Altimeter-derived Wave Heights





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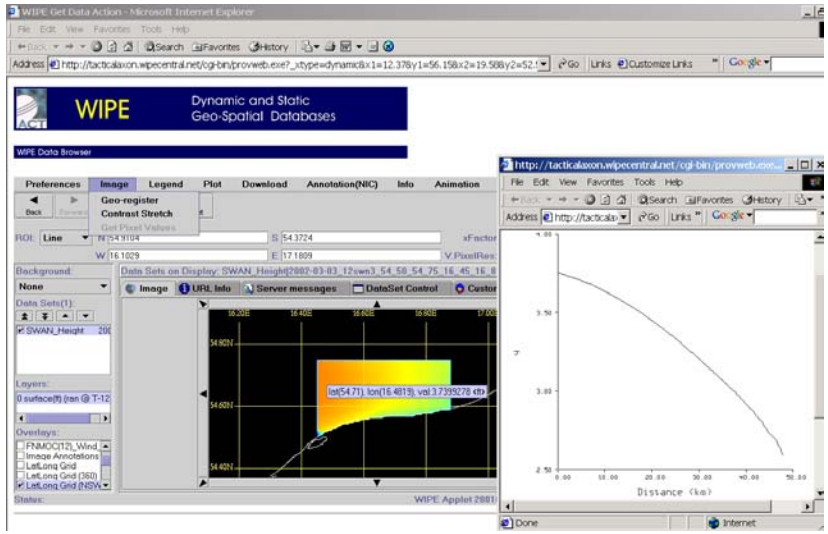
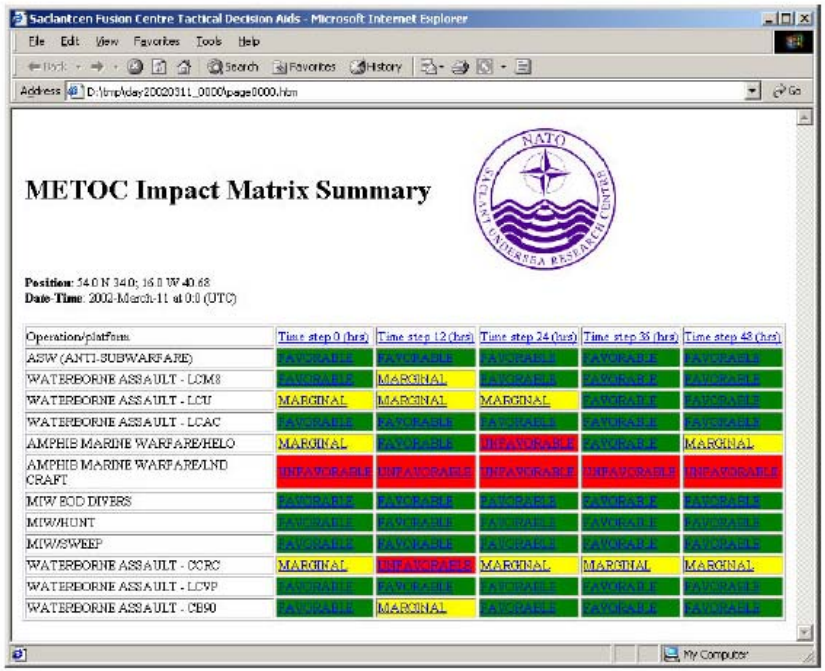
SWAN Output Displayed in WIPE





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MILLENIUM CHALLENGE 2002

- DIOPS products used by Special Operations personnel for operations.
- Also used by amphibious operators putting forces ashore.
- Tropical Cyclone off Baja created sizable wave and surf conditions
- Favorable comments returned to DIOPS project
- One observation received with reasonable comparison to forecasted parameters.

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SURF Forecast

	Sig Brkr Ht	Max Brkr Ht	Brkr Per.
Observation VT 27/07-10Z	**0.9554**	**1.2739**	**12**
251200Z Forecast VT 27/06Z	1.0191	1.5605	13.8
251200Z Forecast VT 27/12Z	1.0191	1.5605	13.8
261200Z Forecast VT 27/06Z	1.0828	1.6242	13.8
261200Z Forecast VT 27/12Z	1.0828	1.6242	13.8
271200Z Forecast VT 27/12Z	1.0510	1.5924	13.8

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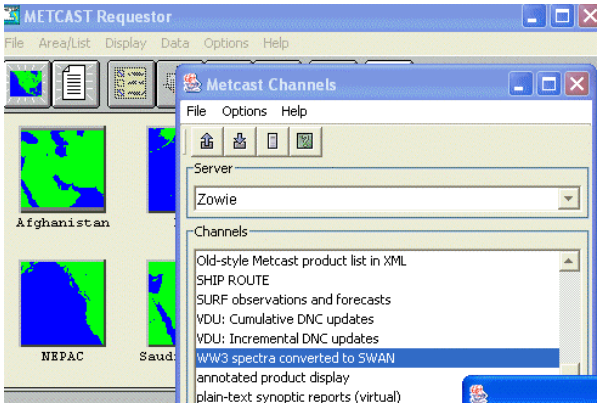
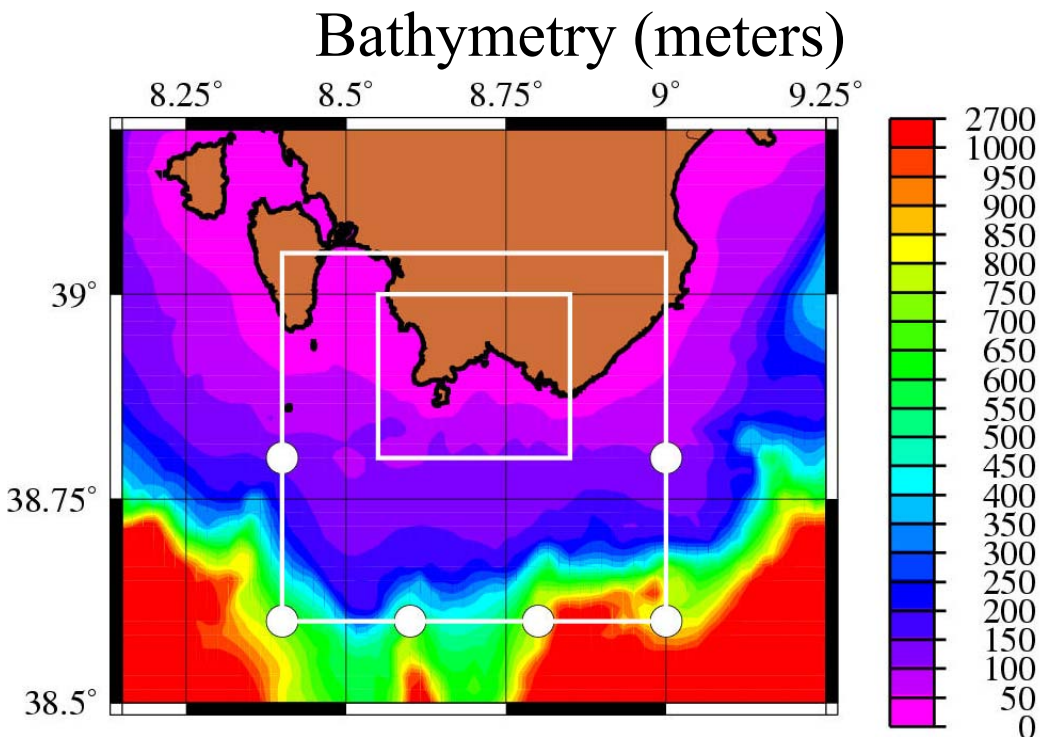
WW3 Spectra in DIOPS



METCAST provides FNMOC WaveWatch3 directional wave spectra to DIOPS to initialize SWAN.



White circles denote locations of WW3 spectra applied to SWAN outer nest.

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Feedback from Fleet on the need for better GUI design (NITES Program)

- Don't put up pop-up windows that can cover the chart or get lost behind the chart.
- Eliminate Pop Up boxes with "OK" and Cancel".
- Minimize the number of button pushes for the operator.
- Make the GUI intuitive to use.

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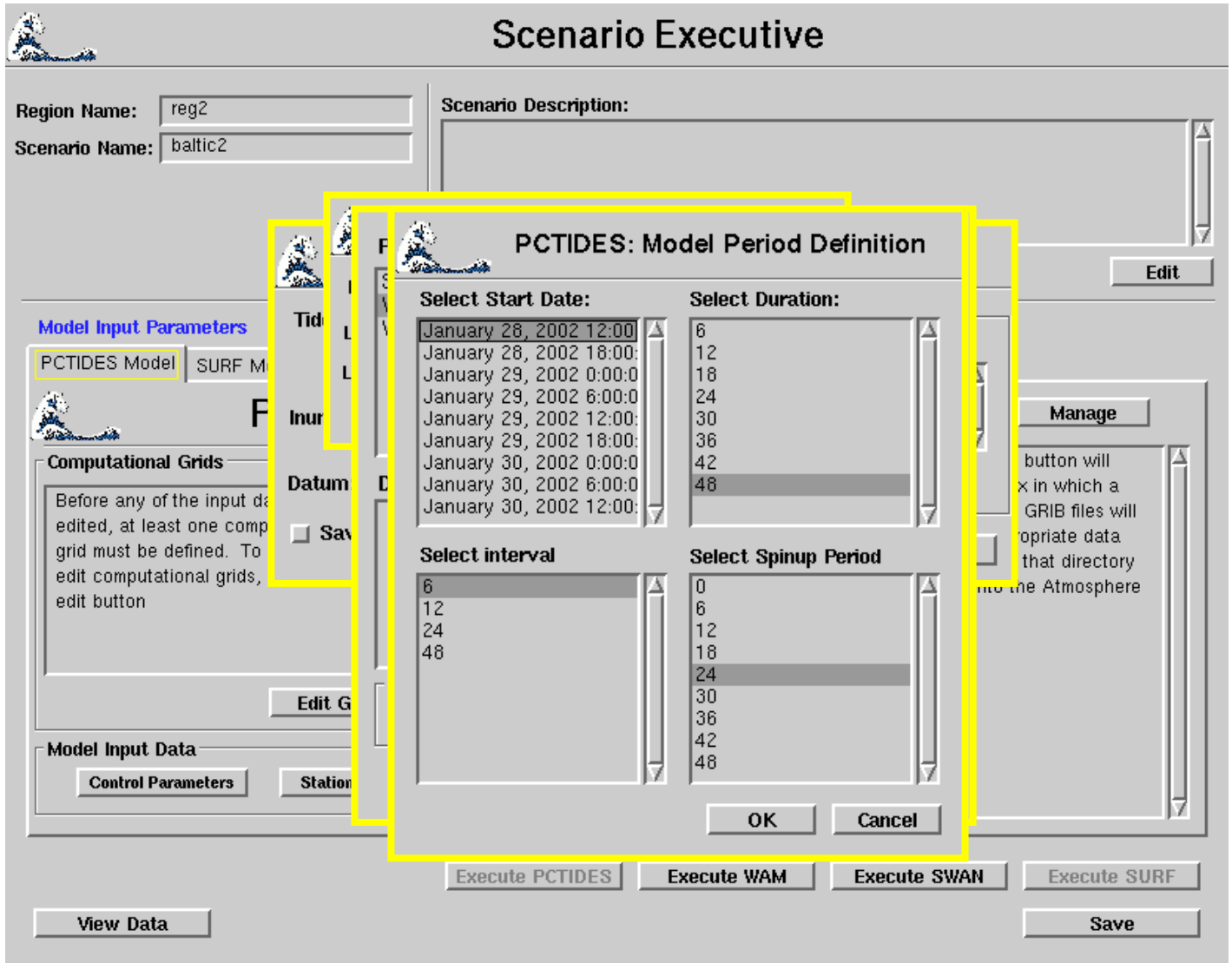
Current (V2.0) DIOPS GUI



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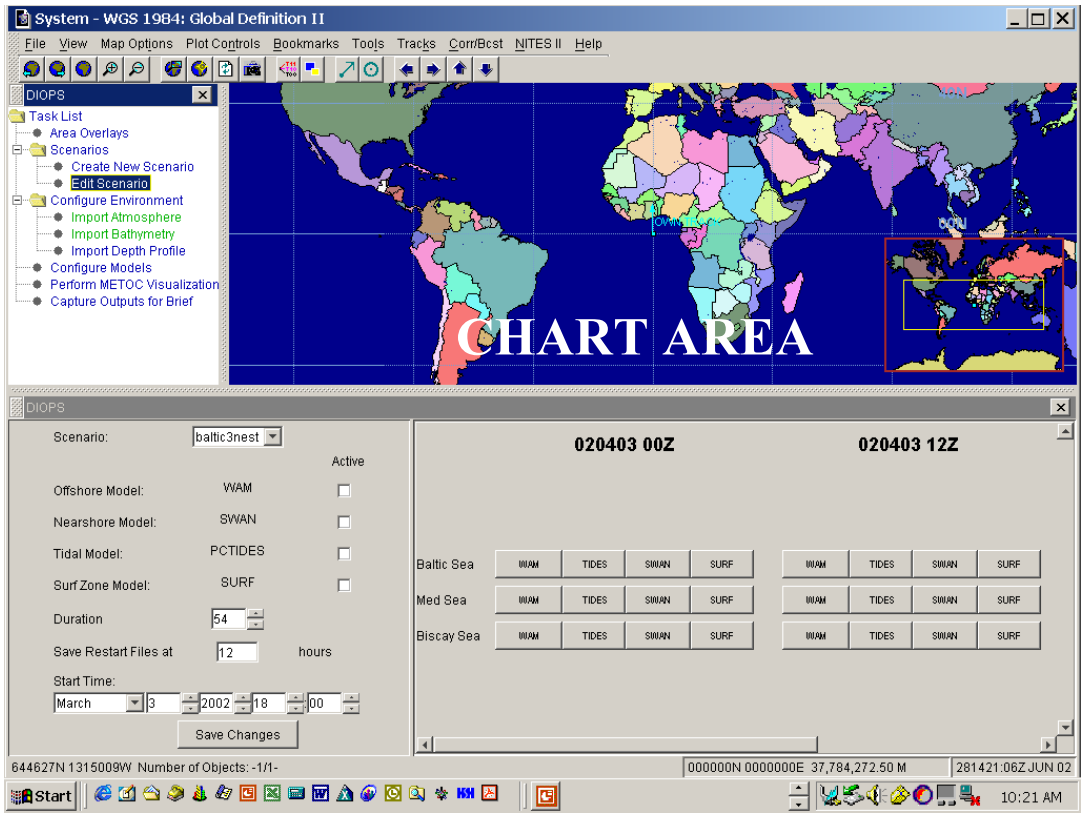
Redesigned DIOPS GUI

Task Area:

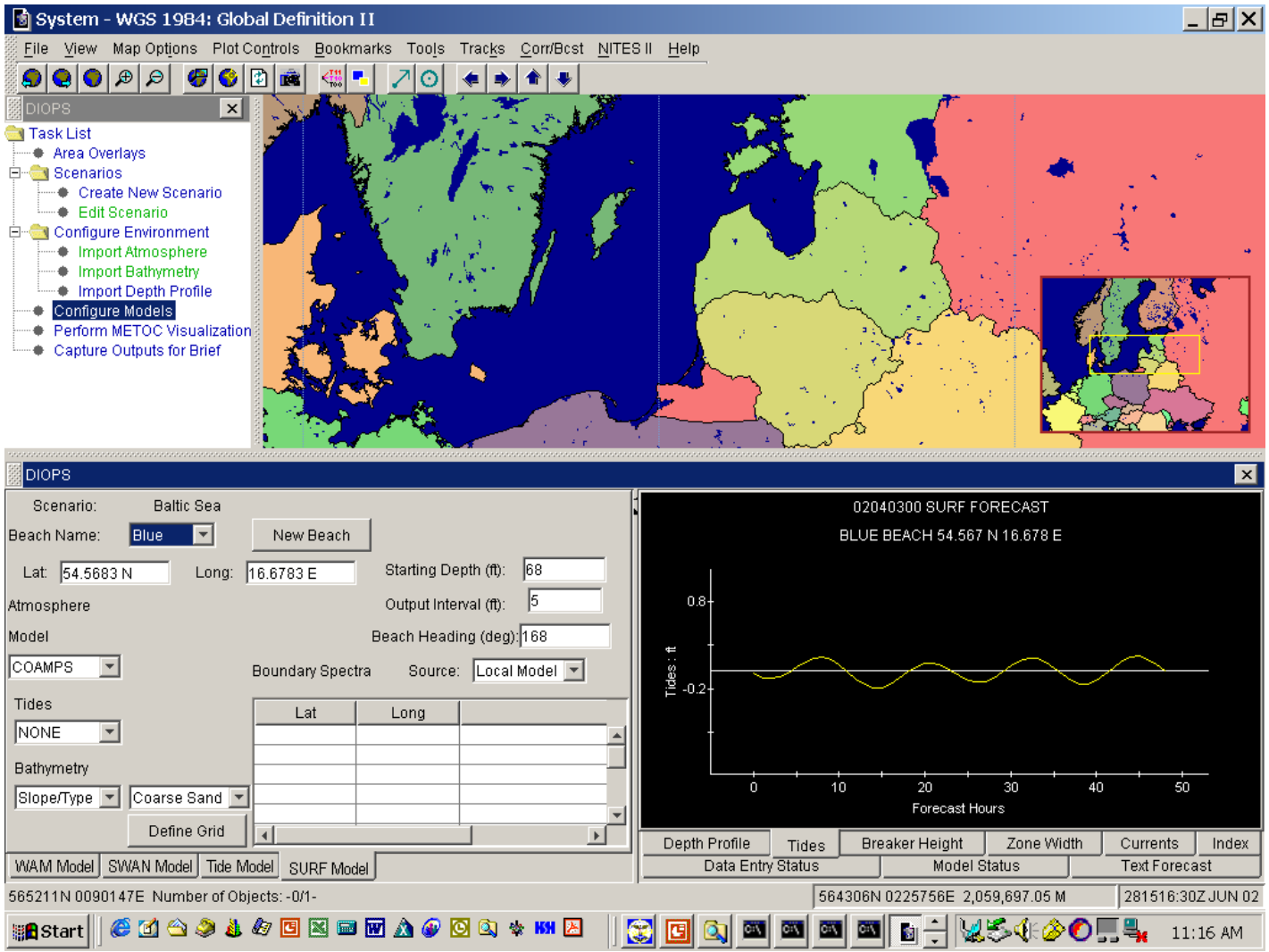
Provides operator list of tasks.

Analysis Area:

Contains screens for DIOPS applications.



DIOPS SURF GUI



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Future DIOPS Plans

- Redesigned GUI to be incorporated into DIOPS
- Delft 3D RTP
- Operational Integration NPMOC-SD
- Fleet Battle Experiment – KILO
- Maritime 2003 REA (w/SACLANTCEN)
- Upgrade to SURF3.2
- Port DIOPS to Linux Platform
- Validate DIOPS vs. DUCK data

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Delft3D Prediction System Overview

The Delft3D program is designed for the modeling of waves, currents, sediment transport and bottom changes in coastal, river and estuary regions.

The program allows for interaction between the various modules, utilizing a GUI, to achieve the desired prediction.

Other modules are planned that will facilitate more complex missions: water quality; bottom changes; tidal and shelf currents
Many aspects of the system are well tested

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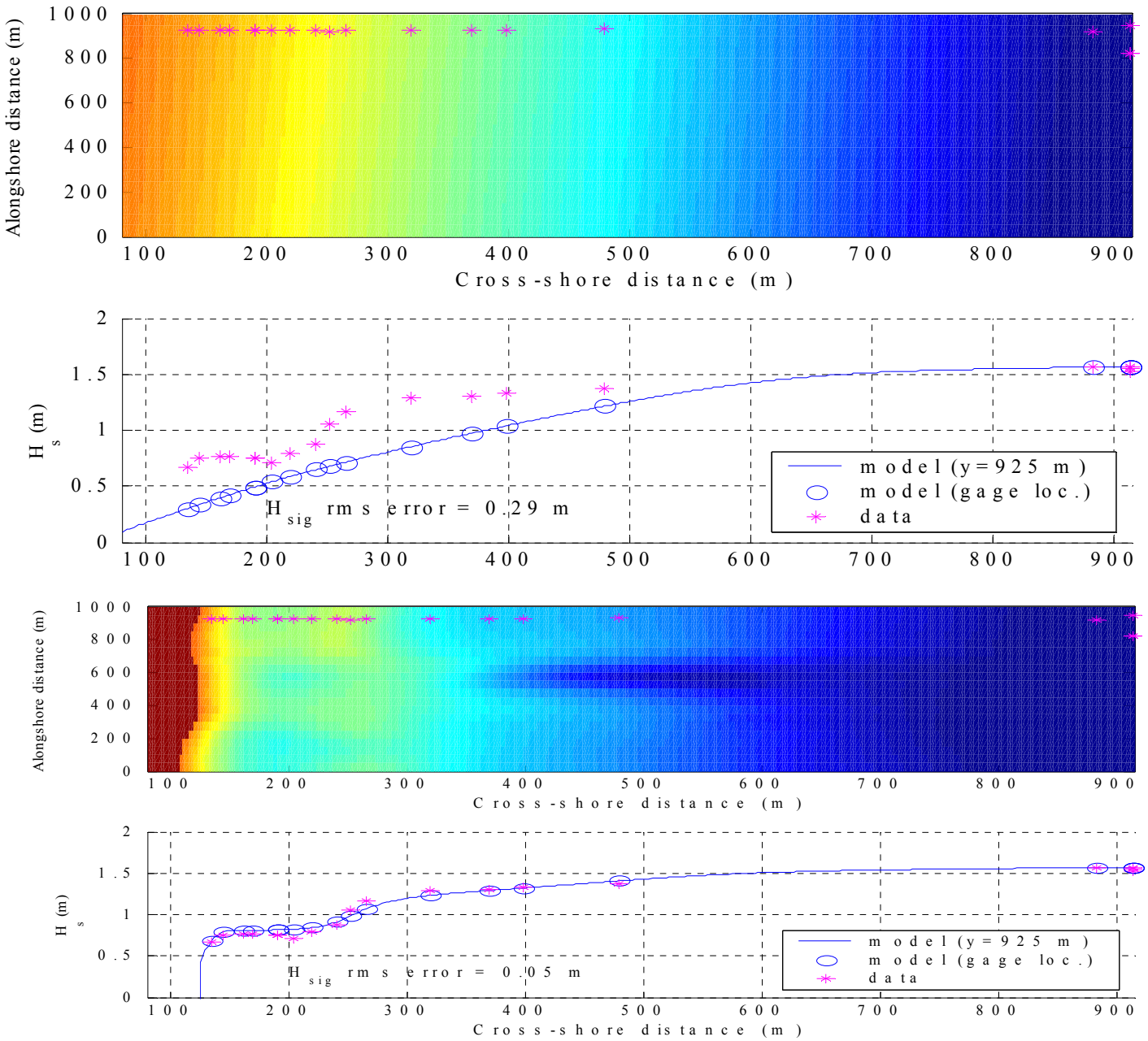
Accurate Bathymetry Affects Simulation Skill



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Summary

- DIOPS Project 3-year effort
- Additional work for integrating Delft 3-D
- Provides operational forecast tool for Navy and Joint METOC forecasters
- Excellent customer feedback during participant exercises
- FBE-K will be the final demonstration before delivery and operational integration

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